Westinghouse Electric Corporation

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Advanced Plans & Program Division (ASZ-5)
Deputy for Systems Management
Hq. Aeronautical Systems Division
Wright-Patterson Air Force Base, Ohio

A18953U

Subject: Contract AF 33(600)40280; Submission of Progress Report for November, 1963; Westinghouse Reference DYD-45196.

Enclosure (1): Three (3) copies of Progress Report for the period of November 1, 1963 to November 30, 1963.

Gentlemen:

In accordance with the subject contract, we are enclosing the monthly Progress Report for November.

Very truly yours,

WESTINGHOUSE ELECTRIC CORPORATION

25X1 [redacted]

Marketing Specialist
Marketing Department

RME/k
Encl.

25X1 cc: [redacted] (With one copy of Enclosure)

IF ENCLOSURES ARE WITHDRAWN (OR NOT ATTACHED), THE CLASSIFICATION OF THIS CORRESPONDENCE WILL BE CANCELLED IN ACCORDANCE WITH PAR 25E AF REGULATION 205-1 OR NAVY REGULATION ARTICLE 76 (5) (11).

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PROGRESS REPORT

Period of November 1 to November 30, 1963

Contract No. AF33(600)40280

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A F-101 FLIGHT TEST

Four flights were made during this reporting period. The last of these flights produced the best results from 40,000 feet altitude to date, with the best resolution and strongest return. Consistency of the mapping was notable, with almost no variation over the full film on both near and far ranges. Targets identified and resolved are the cities of Winchester, Va., Keyser, Romney and Charles Town, W. Va., bridges and bridge construction, limits of highway construction, fish hatcheries, an oil tank farm near Woodbine, Md., and orchards at Romney and Charles Town.

Video level fluctuations in azimuth dimension are present on all flights, which the instrumentation recordings indicate are caused by antenna pitch variations. These pitch variations are caused by loose DFT control. Minimum antenna fluctuations of 0.5 peak to peak can be detected on the correlated film.

Typical dot dimensions on correlated film are 5 to 7 mils (18 to 25 feet) range dimension and 3 to 7 mils (15 to 35 feet) azimuth dimension. Dots with 3 mil (15 feet) azimuth separation are recorded.

Flight 85 film exhibits very strong video with good contrast and definition, since receiver attenuation could be reduced to zero after DFT improvements provided stable antenna control without added receiver attenuation.

Improvement in the correlation effort is noticeable, especially in the far range sector. The far range picture had been consistantly defocused with dots elongated in the range dimension. The defocusing

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has been improved and, on flight 85, the dots are comparable in size and shape to those in the near range sector.

INSTRUMENTATION

The antenna accelerometer and antenna velocity channels of instrumentation were replaced with recordings of DFT Gate output and DFT video signals to allow both ground and in-flight analysis of DFT operation. These recordings revealed that a spectra of energy existed at zero frequency as well as at the off-set frequency. The zero doppler spectrum was caused by the large signal input acting as its own local oscillator. The radar operator's DFT meter indicated 220 cps when it should have been 840 cps The frequency indication was held low by the DC lobe around the PRF line. DFT operation was improved by reducing the signal input to the tracker to a point that provided sufficient signal to noise to permit tracking but reduce the zero doppler spectrum to a minimum.

SYSTEM

No in-flight failures were encountered with the system. Two receiver malfunctions occurred during ground check operation.

Overall receiver noise was lowered by changing the IF amplifier and adjusting TWT operating voltages.

Experimental model crossed-field amplifier transmitter number 001 was installed in place of the breadboard model. The new CFA transmitter doubled peak and average transmitter power, giving 600 kw.

The input circuit to the DFT mixer was modified to reduce the amplitude of the applied video. Also, the DFT antenna servo loop was modified to provide either a fast or slow integration time in the tracker output amplifier. The long integration time will

eliminate fast antenna motions but still maintain response to long term drift angle changes.

B AIR FORCE FLIGHT TEST

A schematic showing modification of the system interconnection for the instrumentation changes has been completed. Modification on frame #3 is half complete. Wiring of the Programmer and instrumentation units is 60 per cent complete. These units will be mounted off frame just forward of the Recorder. A modified Power Meter HP431B is included to measure transmitted power.

An interface electrical schematic was prepared to facilitate communication with the customer and Minneapolis-Honeywell. Shielding changes on the wiring for the Motion Compensation requested by Minneapolis-Honeywell were included on this drawing.

No serious problem was encountered when the frame and truss were fitted in the vehicle. Cable connections will be checked.

Quick disconnect waveguide flanges are being investigated to facilitate noise figure measurements on the frame. Antenna boresight instructions have been written and supplied to the customer.

C ENVIRONMENTAL TEST

RECORDER #6 VIBRATION

Vibration in all axes was completed on the #6 recorder to evaluate the efficiency of the following isolator configurations:

Lord JA8350 isolators mounted normally at 90° to the roll and yaw axes and parallel to the pitch axis.

Lord JA8350 isolators mounted at 90° to the yaw axis and 45° to the pitch and roll axes.

Lord J7148 isolators mounted normally.

Results of these tests showed less film degradation using the Lord JA8350 isolators mounted normally. However, good isolation was not obtained under all conditions with these isolators for vibration above 350 cps in the pitch axis or above 450 cps in the yaw axis.

Vibration was also performed in the yaw and pitch axes using the JA8350 isolators and the J7148 isolators with recorder covers removed to evaluate effects of cover vibration. Film degradation was slightly less for normal mount of JA8350 isolators with the recorder covers removed at vibration in the yaw axis above 300 cps.

ANTENNA PRESSURE-TEMPERATURE

Pressurization leakage tests were performed on the antenna at the design temperature, 500°F. The leakage rate at 489°F was 25 psi in 30 seconds compared to an allowable rate of 10 psi in 10 minutes. Investigation showed the fabric on one of the radiating sticks had delaminated. Several other small leaks were found at the joints between the sticks and manifolds, and at the stick load screws. It is felt that the leaks at the manifold joints may have occurred during vibration, but the pressure seal on the laminate was maintained by the silicone rubber compound until the temperature was increased.

D DESIGN EVALUATION

The report on correlator spatial filtering was edited and released as STM-146. No other studies are underway.

E RECORDER

Modifications to Recorder 6 include:

1. Conversion to Eastman type 4401 thin based film. This film is a Plus-X emulsion on a 2.5 mil milar base, which increases film capacity from 250 to 500 foot capacity.

2. Sweep driver modification to reduce the tendency to oscillate and reduce average transistor dissipation.

3. Increase in focus control potential to accommodate a wider variation in the cathode ray tube parameters.

4, Lowered impedance of focus modulation circuit to prevent loading by the high voltage power supply.

5. Addition of two ten second delays in the turn-on procedure of the high voltage power supply in addition to the original 60 second warm-up period.

Recorder #4 was returned to Itek for adjustment, clean-up, and repair of some minor items.

The 1 to 1 lens was returned to the manufacturer to aid in the design of a field flattening attachment. It is intended that this attachment be added to existing recorders to improve edge resolution.

A vibration test was made of a new design on the M-3 mirror casting. The conclusion reached is that the current design is mechanically adequate, though more complex to adjust during alignment.

Two more high voltage power supplies have been received after modification by the supplier. The first of these supplies has passed all performance tests and after operating for 75 hours it was installed in Recorder #6. Electrical acceptance tests were

started on the second H.V. supply.

General evaluation has started on the CRT sweeps. Results of the measurements on sweep timing, linearity and bowing thus far indicate that none of these items prevent the unit from producing adequate maps but must be considered in future designs.

F WESTINGHOUSE CATHODE RAY TUBE POWER SUPPLY

The low voltage section of the power supply was checked out using the breadboard high voltage section. After checking the high voltage section in liquid freon, it was then potted in Sylgard #184.

Several problems have been encountered since potting. Instability in the 4 KV was corrected by changing to a different type of switching transistor. The input current was reduced slightly by using speed-up capacitors in the base circuits of the switching transistors.

G ANTENNA

All drawings of the interconnecting waveguide have been released for the fabrication of two sets. One set has been completed and tested. Insertion loss measured 1.0 db and VSWR 1.1:1.

Aluminum waveguide of 6061-Al cannot be purchased in the T6 condition. Waveguide manufacturers purchase round tube stock of 6061-Al in O condition and rework it to rectangular shape. The resultant waveguide is somewhere between the O and T3 conditions but not specified, guaranteed or uniform throughout the piece. Firms having the capability to heat treat the waveguide indicated that in addition to the problem of distortion the major problem would be the shrinkage of the inside cross section dimensions by .007 to .012 inches during heat treat. Substitute materials are

not completely satisfactory at elevated temperatures. It was decided to use the aluminum waveguide without heattreat for the interconnecting waveguide.

A visit was made to the Dupont Corp. plant in Fairfield, Connecticut, to discuss the problem of delamination of the fabric seal. Much effort has been expended in an attempt to find a solution. Dupont was pessimistic about solving this problem with changes in manufacturing techniques and are now concentrating their efforts on a new but similar resin. The use of this new resin shows much promise in solving the delamination problem but the resultant laminate must be tested fully for RF, thermal and bonding conditions before it could be considered as a replacement for the ML Fabric. To this end a testing program is being prepared to test this and any other materials that may have been recently developed.

H SYNCHRONIZER

The breadboard Frequency Generator was tested using the Field Test Equipment and found to have a broadbanded control response and an 18 cps deviation due to noise. The breadboard unit was improved significantly by (a) obtaining the fixed frequency output from a different point than the buffer stage that drives the offset mixer and (b) adding a large integrating capacitor to narrow the control bandwidth to 35 cps and also reduce the fm of the VFO.

Drafting is complete on the diode switch and driver circuitry, now called Frequency Generator Output Gate. Fabrication will start immediately. This gate provides 70 db of isolation against leakage of the Fixed Frequency output into the mixer during the inter-pulse periods. The ON-time for the gate is set at 4 microseconds.

I MOTION COMPENSATION

All three of the motion compensation electronics with roll table have been accepted from Honeywell. The first unit, however, was returned for some rework, including an improvement of the accelerometer and a change of wiring harness to make this identical with the final two units.

During tests on the number two unit tied to a mechanically accurate dummy antenna, several problems have developed. The sliding bearing support which operates at high temperature without lubrication chatters and binds. Even with lubrication it is not ideal. This unsolved problem requires further investigation by the actuator supplier, but changes in bearing friction will affect servo operation, however. The frequency response of the antenna yaw motion appears slow, but actual measurements are not complete. Finally, the antenna displacement with respect to yaw voltage command is non-linear. Linearity of the actuator and LVDT pickoff is being checked with the actuator supplier. Gain of the actuator position transducer is not determined by the supplier and may require matched transducers. These problems will have to be corrected before delivery because of the importance found in flight test of the angle compensation.

J FIELD TEST EQUIPMENT

Full tests of the Field Test Equipment with the system have not been possible because of the lack of some radar subassemblies. The FTE was used for the series of tests on the breadboard, Frequency Generator and for DFT tests on the F-101 equipment.